



## **ENVIRONMENTAL PROTECTION AGENCY**

### **40 CFR Part 268**

**[EPA-HQ-OLEM-2023-0372; FRL 11026-04-OLEM]**

### **Department of Energy Hanford Mixed Radioactive Waste Land Disposal Restrictions Variance**

**AGENCY:** Environmental Protection Agency (EPA).

**ACTION:** Proposed rule.

**SUMMARY:** The United States Environmental Protection Agency (EPA) is proposing to grant a treatability variance from the Land Disposal Restrictions (LDR) treatment standards for the U.S. Department of Energy (DOE) for approximately 2,000 gallons of mixed low-activity waste from the Hanford Site in Washington State. The petitioner demonstrated that treatment of the waste to the specified standard is technically inappropriate, and the treatment variance is sufficient to minimize threats to human health and the environment posed by land disposal of the waste. If the variance is granted, the waste will be stabilized subject to specified conditions, and disposed at *EnergySolutions* in Clive, Utah and/or Waste Control Specialists in Andrews County, Texas. The variance would allow DOE, Washington, and EPA to evaluate the regulatory pathways by which separation, pretreatment, stabilization, and offsite disposal could be implemented for other Hanford mixed low-activity waste.

**DATES:** Comments must be received on or before **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

**ADDRESSES:** You may send comments, identified by Docket ID No. EPA-HQ-OLEM-2023-0372, by any of the following methods:

- Federal eRulemaking Portal: <https://www.regulations.gov/> (our preferred

method). Follow the online instructions for submitting comments.

- Mail: U.S. Environmental Protection Agency, EPA Docket Center, Office of Land and Emergency Management Docket, Mail Code 28221T, 1200 Pennsylvania Avenue NW, Washington, DC 20460.
- Hand Delivery or Courier: EPA Docket Center, WJC West Building, Room 3334, 1301 Constitution Avenue, NW, Washington, DC 20004. The Docket Center's hours of operations are 8:30 a.m. – 4:30 p.m., Monday – Friday (except Federal Holidays).

*Instructions:* All submissions received must include the Docket ID No. for this rulemaking. Comments received may be posted without change to <https://www.regulations.gov/>, including any personal information provided. For detailed instructions on sending comments and additional information on the rulemaking process, see the “Public Participation” heading of the **SUPPLEMENTARY INFORMATION** section of this document.

**FOR FURTHER INFORMATION CONTACT:** Bethany Russell, Waste Characterization Branch, Materials Recovery and Waste Management Division, Office of Resource Conservation and Recovery (5304P), Environmental Protection Agency, 1200 Pennsylvania Ave, N.W., Washington, D.C. 20460; telephone number: 202-566-0823; email address: [russell.bethany@epa.gov](mailto:russell.bethany@epa.gov).

## **SUPPLEMENTARY INFORMATION:**

### **I. Public Participation**

#### *A. Docket*

EPA has established a docket for this action under Docket ID No. EPA-HQ-OLEM-2023-0372. All documents in the docket are listed in the <https://www.regulations.gov> index. Publicly available docket materials are available

either electronically at <https://www.regulations.gov> or in hard copy at the EPA Docket Center. The Public Reading Room for the docket is open from 8:30 a.m. to 4:30 p.m. Eastern, Monday through Friday, excluding holidays. The telephone number for the Public Reading Room and Docket Center is (202) 566-1744.

### *B. Written Comments*

Submit your comments, identified by Docket ID No. EPA-HQ-OLEM-2023-0372, at <https://www.regulations.gov> (our preferred method), or the other methods identified in the **ADDRESSES** section. Once submitted, comments cannot be edited or removed from the docket. The EPA may publish any comment received to its public docket. Do not submit electronically any information you consider to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Multimedia submissions (audio, video, etc.) must be accompanied by a written comment. The written comment is considered the official comment and should include discussion of all points you wish to make. The EPA will generally not consider comments or comment contents located outside of the primary submission (i.e. on the web, cloud, or other file sharing system). For additional submission methods, the full EPA public comment policy, information about CBI or multimedia submissions, and general guidance on making effective comments, please visit <https://www.epa.gov/dockets/commenting-epa-dockets>.

### *C. Submitting CBI*

Do not submit information that you consider to be CBI electronically through <https://www.regulations.gov> or email. Send or deliver information identified as CBI to only the following address: ORCR Document Control Officer, Mail Code 5305-P, Environmental Protection Agency, 1200 Pennsylvania Avenue NW, Washington, DC 20460; Attn: Docket ID No. EPA-HQ-OLEM-2023-0372.

Clearly mark the part or all of the information that you claim to be CBI. For CBI information in a disk or CD-ROM that you mail to EPA, mark the outside of the disk or CD-ROM as CBI and then identify electronically within the disk or CD-ROM the specific information that is claimed as CBI. In addition to one complete version of the comment that includes information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket. If you submit a CD-ROM or disk that does not contain CBI, mark the outside of the disk or CD-ROM clearly that it does not contain CBI. Information marked as CBI will not be disclosed except in accordance with procedures set forth in 40 Code of Federal Regulations (CFR) Part 2.

## **II. General Information**

### *A. Does this document apply to me?*

This action applies only to DOE's Hanford facility located in Richland, Washington.

### *B. What action is the Agency taking?*

On August 2, 2023, the EPA received a petition from the DOE requesting a variance from a treatment standard of the LDR of 40 CFR 268.40 for disposal of approximately 2,000 gallons of hazardous wastes generated from DOE's Test Bed Initiative (TBI). This document proposes to grant DOE's petition for a variance pursuant to 40 CFR 268.44.

### *C. What is the Agency's authority for taking this action?*

Sections 3004(d) through (g) of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6294(d)-(g), prohibit the land disposal of hazardous wastes unless such wastes meet the LDR treatment standards (or treatment standards) established by EPA (or the Agency). Section 3004(m) of RCRA, 42 U.S.C. 6924(m), requires EPA to set levels or methods of treatment, if any, which substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste so that short-term and long-term threats to human health and the environment are minimized. EPA has established treatment standards for all hazardous wastes.

However, when facilities generate hazardous wastes which cannot be treated to the specified levels, or when it is technically inappropriate for such wastes to undergo the prescribed treatment, they can apply for a variance from a treatment standard.<sup>1</sup> The requirements for a treatment variance are found at 40 CFR 268.44. An applicant for a treatment variance may demonstrate that it is inappropriate to require a waste to be treated to the level or by the method specified as the treatment standard, even though

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<sup>1</sup> See 51 FR at 40605-40606 (November 7, 1986); see also 62 FR 64504 (December 5, 1997).

such treatment is technically possible. This is the criterion pertinent to today's action.<sup>2</sup>

The petitioner must also demonstrate that compliance with any given treatment variance is sufficient to minimize threats to human health and the environment posed by land disposal of the waste.

### **III. Background**

#### *A. Hanford Waste Description*

Nearly 56 million gallons of radioactive and hazardous waste (mixed waste) were generated from the Hanford Site's role in our nation's defense program during the Manhattan Project and the Cold War.<sup>3</sup> A total of 149 single shell tanks (SSTs) were constructed and entered service at Hanford between the 1940s and 1960s to contain this waste. Beginning in the 1960s, an additional 28 double shell tanks (DSTs) were also constructed at Hanford. DST capacity is crucial for retrieval of SST waste. Between the 1940s and the mid-1980s, approximately 240,000 tons of hazardous chemicals were added to Hanford's tanks.<sup>4</sup>

DOE regulates certain radioactive materials, including the radioactive portion of mixed waste at Hanford, pursuant to its self-regulating authority under the Atomic Energy Act of 1954 (AEA), 42 U.S.C. 2011, et seq. The Washington State Department of Ecology (ECY) regulates the hazardous portion of the mixed waste as dangerous waste pursuant to the Revised Code of Washington (RCW) Chapter 70A.300 and Washington

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<sup>2</sup> According to 42 CFR 268.44(a)(2), a petitioner may obtain a variance from an applicable treatment standard if it is inappropriate to require the waste to be treated to the level specified in the treatment standard or by the method specified as the treatment standard, even though such treatment is technically possible. To show that this is the case, as applicable here, the petitioner must demonstrate that treatment to the specified level or by the specified method is technically inappropriate (for example, resulting in combustion of large amounts of mildly contaminated environmental media). Section 268.44(m) further requires the petitioner to demonstrate that compliance with any given treatment variance is sufficient to minimize threats to human health and the environment posed by land disposal of the waste.

<sup>3</sup> See Hanford Test Bed Initiative Fact Sheet, July, 2018, <https://www.energy.gov/sites/prod/files/2018/07/f53/Hanford%20Test%20Bed%20Initiative%20Fact%20Sheet%207-12-18.pdf>.

<sup>4</sup> Government Accountability Office, GAO 22-104365, *Nuclear Waste Disposal: Actions Needed to Enable DOE Decision That Could Save Tens of Billions of Dollars* (2021), at 7.

Administrative Code (WAC) Chapter 173-303, as a State authorized to implement a hazardous waste program under the Resource Conservation and Recovery Act (RCRA).

Under RCRA and RCRA-authorized Washington regulations, mixed wastes are generally subject to the treatment standards in 40 CFR 268.40. Where there is no specific treatment standard set forth for a mixed waste, the standard applicable to the hazardous waste code applies to the mixed waste. For certain mixed wastes, specific treatment standards have been established. Treatment by high-level vitrification (HLVIT) applies to the subcategory of radioactive high-level mixed wastes generated during the reprocessing of fuel rods and bearing the waste codes D002 and/or D004 through D011.<sup>5</sup> EPA selected vitrification as the Best Demonstrated Available Technology (BDAT) for this waste, and established HLVIT as the treatment standard, in part because stabilization would not provide treatment of the high-level radioactive portion of the waste, and because the potential health hazards associated with exposure to radioactivity during analysis of this high-level mixed waste precluded setting a concentration-based treatment standard.<sup>6</sup>

## B. Description of the Proposed Treatment and Disposal

In 2013, DOE updated its decision to separate tank wastes with low levels of long-lived radionuclides (referred to as low-activity waste or LAW) from other tank waste, and to vitrify some of the LAW at Hanford's Tank Waste Treatment and Immobilization Plant (WTP). The vitrified waste form will be disposed of onsite at Hanford's Integrated Disposal Facility (IDF). The WTP has the design capacity to treat only around 60 percent of the LAW from the Hanford tanks.<sup>7</sup> For the remaining LAW, DOE did not select a treatment method and found it would be "beneficial to study further

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<sup>5</sup> See WAC 173-303-140, which incorporates by reference 40 CFR 268 at WAC 173-303-140(2)(a).

<sup>6</sup> 55 FR 22520, 22627 (June 1, 1990).

<sup>7</sup> See GAO 22-104365, *Actions Needed to Enable DOE Decision That Could Save Tens of Billions of Dollars* (2021), at 2.

the potential cost, safety, and environmental performance of supplemental treatment technologies.”<sup>8</sup> DOE therefore proposed the TBI Demonstration.

DOE describes the TBI Demonstration as: (1) the onsite separation and pretreatment of supernate from Tank SY-101, located in the 200 West Area on the Central Plateau of the Hanford Site to remove the bulk of the key radionuclides from the supernate; (2) transport of the pretreated liquid waste to an offsite treatment facility for treatment using stabilization/solidification (grouting); and (3) disposal of the grouted waste form at a commercial disposal facility outside the State of Washington. Effectuating the TBI Demonstration would allow DOE, Washington, and EPA to evaluate the regulatory pathways by which separation, pretreatment, stabilization (grouting), and offsite disposal could be implemented for other Hanford mixed low-activity waste. Concurrently, DOE is applying for a Research Development & Demonstration (RD&D) Permit from ECY to perform the onsite pretreatment activities associated with the TBI Demonstration.<sup>9</sup>

On August 2, 2023, DOE submitted to EPA a petition for a treatment variance under 40 CFR 268.44(a)(2) to implement the TBI Demonstration by treating approximately 2,000 gallons of supernate from Tank SY-101.<sup>10</sup> DOE selected Tank SY-101 for the TBI because of, among other reasons, the tank waste chemistry, including low organic concentration.<sup>11</sup> Separation and pretreatment would involve filtration of solids, and use of a crystalline silicotitanate ion exchange media to capture and remove key radionuclides (including cesium (Cs-137) and daughter barium (Ba-137m) and strontium (Sr-90)) from the supernate. Tank SY-101 consists of two layers: the supernate, which

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<sup>8</sup> See 78 FR 75916.

<sup>9</sup> U.S. Department of Energy, ORP-67633, *2,000-Gallon Test Bed Initiative Demonstration Research, Development, and Demonstration Permit Application*, Revision. 0 (June 8, 2023) (hereinafter, RD&D Permit Application).

<sup>10</sup> U.S. Department of Energy, 23-TF-0023, *Test Bed Initiative Land Disposal Restrictions Variance Petition* (August 1, 2023).

<sup>11</sup> U.S. Department of Energy, *Test Bed Initiative at Hanford, Report to Congress* (April 2019), at 7.

comprises approximately 81 percent of the tank volume, and an undissolved salt cake layer beneath the supernate.

As requested in the petition and provided in this proposal, the pretreated supernate would be subject to a stabilization treatment method, hereafter referred to as STABL, with verification sampling to ensure the treated waste meets the numerical LDR treatment standards applicable to the waste codes provided in this proposal. The offsite commercial treatment facilities identified in the petition, *EnergySolutions* and Waste Control Specialists, would be required to conduct the stabilization treatment in compliance with their RCRA permits, as well as their radioactive material licenses.

DOE anticipates that half of the pretreated liquid would be transported to *EnergySolutions* for grouting and disposal at its commercial facility in Clive, Utah, and half would be transported to Waste Control Specialists for grouting and disposal at its Federal Waste Facility (FWF) in Andrews County, Texas.<sup>12</sup> The process totes used to transport the pretreated liquid waste offsite to *EnergySolutions* and Waste Control Specialists for treatment would meet all applicable U.S. Department of Transportation (USDOT) requirements under 49 CFR Subchapter C.

In accordance with DOE Order 435.1 Chg 2(AdminChg), *Radioactive Waste Management* and DOE Manual 435.1-1 Chg 3(LtdChg), *Radioactive Waste Management Manual*, DOE completed a Waste Incidental to Reprocessing (WIR) Evaluation for the 2,000-gallon TBI Demonstration in March 2023.<sup>13</sup> Based on the WIR Evaluation, DOE determined that the separated, pretreated, and solidified supernate from Tank SY-101 is

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<sup>12</sup> See U.S. Department of Energy, *Memorandum: Approval of Exemption of Use of Non-U.S. Department of Energy Facilities for the 2,000-Gallon Test Bed Initiative Demonstration* (June 8, 2023).

<sup>13</sup> U.S. Department of Energy, DOE/ORP-2022-02, Revision 0, *Final Waste Incidental to Reprocessing Evaluation for the Test Bed Initiative Demonstration* (hereinafter, Final WIR Evaluation) (March 2023); see 88 FR 16615 (March 20, 2023).  
[https://www.hanford.gov/files.cfm/WIR\\_%E2%80%93\\_Final\\_WIR\\_Evaluation\\_for\\_the\\_TB11.pdf](https://www.hanford.gov/files.cfm/WIR_%E2%80%93_Final_WIR_Evaluation_for_the_TB11.pdf).

waste incidental to the reprocessing of spent nuclear fuel, is not high-level waste, and can be managed as a low-level waste.<sup>14</sup>

DOE also completed a Final Environmental Assessment (Final EA) for the 2,000-gallon TBI Demonstration in accordance with the National Environmental Policy Act (NEPA), and DOE's NEPA implementation regulations, 10 CFR Part 1021.<sup>15</sup> In the Final EA, DOE analyzed the environmental impacts associated with four combinations of facilities for grouting and disposal of the pretreated 2,000 gallons of supernate from Tank SY-101. The EA evaluated potential impacts of the TBI Demonstration to air quality, human health (both from normal operations and accidents or destructive acts), waste management, and transportation. Any proposal to separate, pretreat, stabilize, and dispose of any tank waste other than the TBI supernate from Tank SY-101 would be evaluated in a separate NEPA review. DOE sent the draft EA with a request for input to host States and Tribes as well as States and Tribes that could be affected by the proposed action, as documented in Section 4 of the EA.<sup>16</sup> DOE determined that the four alternatives analyzed for grouting and disposal will not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of NEPA, and therefore issued a Finding of No Significant Impact (FONSI) on March 16, 2023.<sup>17</sup>

#### **IV. Basis for EPA's Proposed Determination**

##### *A. EPA's Approach to this Proposed Variance*

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<sup>14</sup> WIR Determination.

<sup>15</sup> U.S. Department of Energy, *Final Environmental Assessment of the Test Bed Initiative Demonstration*, DOE/EA-2086 (March 2023). [https://www.energy.gov/sites/default/files/2023-03/ea-2086-test-bed-initiative-hanford-2023-03\\_0.pdf](https://www.energy.gov/sites/default/files/2023-03/ea-2086-test-bed-initiative-hanford-2023-03_0.pdf).

<sup>16</sup> The following tribes and State agencies were notified of the preparation of the EA: Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, Yakama Nation Tribe, Wanapum Tribe, Tennessee Department of Environment and Conservation, Texas Commission on Environmental Quality, State of Utah Public Lands Policy Coordination Office, Oregon State Department of Energy, Washington State Department of Ecology.

<sup>17</sup> *Finding of No Significant Impact Test Bed Initiative Demonstration Hanford Site, Washington*, DOE/EA-2086 (March 16, 2023). [https://www.hanford.gov/files.cfm/Final\\_-\\_230316\\_-\\_NEPA\\_FONSI\\_for\\_TBI\\_\(Digital\).pdf](https://www.hanford.gov/files.cfm/Final_-_230316_-_NEPA_FONSI_for_TBI_(Digital).pdf).

The regulatory framework and associated requirements of the RCRA LDR standards must be addressed to implement the 2,000-gallon TBI Demonstration and dispose of the grouted waste form at EnergySolutions in Clive, Utah, and/or Waste Control Specialists in Andrews County, Texas. As mentioned above, the LDR standard under RCRA and RCRA-authorized Washington regulations for the subcategory of radioactive high-level mixed wastes generated during the reprocessing of fuel rods and bearing the waste codes D002 and/or D004 through D011 is HLWIT. DOE asserts that after Tank SY-101 supernate is processed through TBI, including separation of high- and low-activity waste fractions, pretreatment, and solidification, following a re-classification through a WIR determination, the solidified low-activity waste fraction can be managed and disposed as low-level radioactive waste. Once those steps are completed, DOE believes the HLWIT treatment standard does not apply and thus the separated, pretreated mixed waste would not be required to be vitrified. Washington interprets its RCRA-authorized LDR requirements such that the waste designation and all associated LDR treatment standards, including HLWIT, have already attached to the tank waste and remain attached to the separated, pretreated low-activity fraction of the tank waste until satisfied. Thus, according to Washington, if the waste is not vitrified, the HLWIT standard would need to be removed through some regulatory vehicle, such as a treatment variance, in order for that waste to be grouted instead of vitrified.<sup>18</sup>

EPA's decision to propose this treatment variance approval does not resolve DOE and the State's differing interpretations of the LDR requirements, and EPA is not concluding that HLWIT does or does not apply to the TBI waste. Rather, EPA proposes to approve this variance to provide a clear regulatory pathway for the 2,000-gallon TBI to proceed. As documented in a 2021 report by the General Accountability Office,<sup>19</sup> DOE,

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<sup>18</sup> For Washington's statements describing its position, see FFRDC Report 2023, Volume II p. 494-495.

<sup>19</sup> GAO-22-104365.

Washington, and EPA agree that the TBI should proceed, to test the viability of a grouting approach to some of the Hanford tank waste. However, the regulatory disagreement between DOE and Washington remains unresolved. In view of this background -- and the importance DOE, Washington and EPA all attach to making progress on the Hanford tank waste mission -- EPA proposes to approve a variance clearly allowing the TBI to proceed, on the specific terms and subject to the specific conditions proposed today, regardless of whose interpretation forms the starting point for the variance analysis.

Specifically, EPA proposes to subject the TBI waste to a STABL (stabilization) treatment method, with verification sampling to ensure the treated waste meets the LDR numerical standards, as applicable, for waste codes F001-F005 (limited to constituents associated with spent solvent activities at the Hanford facility); D001- D011, D018, D019, D022, D028-D030, D033-D036, D038- D041, and D043. The waste codes included herein are those identified on the Dangerous Waste Permit Application Part A form for the DST System, Rev. 4 (December 14, 2009), which includes Tank SY-101.<sup>20</sup> The codes include listed hazardous wastes bearing organic constituents, and toxic and corrosive characteristic wastes which ordinarily must meet concentration-based treatment standards under Washington's RCRA-authorized program. DOE's petition requests to use STABL to meet the numeric standard, therefore these wastes are included in this variance.

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<sup>20</sup> See *Petition*, Table 1. The data provided in Table 1 is derived from the *Final Analytical Report for Tank 241-SY-101 TBI Grab Sampling 2018*, RPP-RPT-61303 Rev. 05 (October 2020). All waste codes that appear on the DST System Part A form are included in this variance, with the exception of F039 (because the DST System has not accepted waste bearing that waste code). The sample result suggests that Tank SY-101 supernate displays only a limited subset of the waste codes listed on the DST System Part A form. See RD&D Permit Application, Sec. 4.1.2 and Table 4-1. DOE explains that Tank SY-101 supernate does not exhibit the characteristics of ignitability (D001) and reactivity (D003) before or after pretreatment. Nonetheless, EPA understands that Washington views the SY-101 waste as bearing all of the codes on the Part A form (except for F039) and is therefore including the codes in the proposed variance, since the facility is regulated under Washington's authorized program. The inclusion of D001 and D003 does not affect the treatment required by the variance, since treatment for underlying hazardous characteristics for these waste codes is accounted for by the treatment required for the corrosivity (D002) and toxicity (D004-043) characteristics.

Pursuant to 40 CFR 268.44(a)(2)(i), a variance may be approved if it is technically inappropriate to treat the waste to the level specified in the treatment standard, or by the method specified as the treatment standard, even though such treatment is technically possible. As with any section 268.44 treatment variance, the petitioner must also show that compliance with the variance will be sufficient to minimize threats to human health and the environment posed by land disposal of the waste.

## *B. Proposed Technically Inappropriate Determination*

In promulgating the Land Disposal Restrictions for Third Third Scheduled Wastes (Third Third Rule) that established the HL VIT treatment standard, EPA expressly recognized the effectiveness of grouting for immobilizing inorganic hazardous constituents in low-level mixed waste:

The Agency believes that for treatment of metals in low-level mixed wastes and for some TRU mixed wastes containing low radioactive components, chemical precipitation will remove the metals in wastewaters, and stabilization technologies will reduce the leachability of the metal constituents in nonwastewater matrices. These are the same technologies that are applicable to nonradioactive wastes containing metals.

DOE submitted data demonstrating the applicability of stabilization as a treatment technology for the low-level waste fractions that are separated from the high-level waste generated during the reprocessing of fuel rods. As used by one particular facility, a stabilization process called grout stabilization involves blending commercially produced cement-based reagents with the liquid low-level waste fraction. The material sets up as a solid mass, immobilizing the waste. The performance data indicate that stabilization provides immobilization of the characteristic metal constituents and radioactive contaminants for this low-level radioactive waste, and that it is possible to stabilize the RCRA hazardous portions to meet the treatment levels for the characteristic metals. . . .

DOE provided information to support that vitrification is an applicable technology for their high-level wastes generated from the reprocessing of fuel rods. Treatment can be accomplished by using either direct vitrification or a more complex treatment process which includes a series of chemical steps that separate the low-level radioactive waste fractions from the high-level radioactive waste. The high-level radioactive portion is then vitrified. When using separation technologies such as precipitation followed by settling or filtration, the bulk of the radioactivity can be incorporated into a high-level liquid waste containing up to 99 percent of the radioactivity of the original irradiated fuel rods. By separating high-level and low-level mixed wastes, the amount of high-level waste that may require vitrification treatment can be reduced.

[55 FR 22626-2627 (June 1, 1990).]

Tank SY-101 contains both inorganic and organic constituents; however, sampling results from Tank SY-101 supernate<sup>21</sup> show that the organic constituents in the waste are at least one order of magnitude below the applicable nonwastewater (NWW) concentration-based LDR treatment standards except for 1-butanol (also referred to as n-Butyl alcohol).<sup>22</sup> The sample results show that 1-butanol was not detected in the sample, however, the laboratory detection limit (2.78 mg/L) for this constituent is slightly above the NWW concentration-based standard (2.6 mg/kg). Thus, 1-butanol is either below or just slightly above this standard in the pre-treated waste, and EPA is confident that it will meet the LDR standard following treatment, and that grouting is an appropriate treatment technology for this constituent in this waste.

As referenced above, EPA expresses no opinion on whether the waste subject to this proposed variance must be vitrified under ECY's RCRA-authorized LDR regulations. However, EPA believes that, under the facts and circumstances presented in DOE's petition for this waste stream and the terms of this proposed variance, it would be technically inappropriate to require the Tank SY-101 supernate to be treated by vitrification. As explained further below, in view of the efficacy of grout for immobilizing inorganic constituents, the fact that the organics concentrations in the pretreated liquid waste are below (or in the case of 1-butanol, below or just slightly above) the NWW standards, and the protective geologic features of the identified disposal sites, EPA believes that requiring Tank SY-101 supernate to be vitrified would be technically inappropriate. This is because vitrification would require more time to implement, result in additional secondary impacts, and be more costly -- outcomes that EPA considers unnecessary and undesirable in view of its proposed determination that grouting under the terms of the proposed variance would minimize threats.

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<sup>21</sup> See *Petition*, Table 1.

<sup>22</sup> Because the final grouted waste form being disposed of will be a nonwastewater, the NWW standards are the relevant treatment standards for this proposed variance.

The proposed approval applies only to the 2,000 gallons of separated, pretreated supernate from Tank SY-101. Therefore, these distinctions in impacts and outcomes between grouting and vitrifying the waste are small. That said, EPA believes they are tangible in proportion to the amount of waste involved, which is also small. Moreover, the TBI Demonstration is intended to test the viability of an approach involving grouting and offsite disposal for other low-activity waste from Hanford. Thus, the TBI could provide the basis for a broader approach under which these distinctions would be more significant.

First, EPA believes grouting the waste, under the terms of the proposed variance, would speed up implementation of retrieval, treatment and disposal. In a peer-reviewed report issued in 2023, the Federally Funded Research and Development Center (FFRDC) recommended grouting and off-site disposal in parallel to vitrification due to the improved execution schedule and probability of successful project completion when compared to all other effective alternatives for waste beyond the capacity of the existing DFLAW.<sup>23</sup> Tank SY-101 is not currently part of the direct-feed system for vitrification. To vitrify LAW from SY-101 would require construction of new infrastructure. Thus, the TBI would allow the 2,000 gallons of TBI waste to be retrieved, treated, and disposed of more quickly than would otherwise be possible. Conducting TBI in parallel to on-site vitrification of LAW from other tanks could provide multiple pathways for disposal of Hanford tank waste and provide the capability to achieve a more rapid reduction in the amount of waste stored, and therefore result in a more rapid reduction in risk to human health and the environment.<sup>24</sup> Moreover, DST space in West Area is needed to allow for the receipt of waste retrievals from the aging SSTs for vitrification. In 2021 the Government Accountability Office (GAO) reported that insufficient tank space is the top

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<sup>23</sup> FFRDC Report 2023, Volume I page 52

<sup>24</sup> See FFRDC Report 2023 page 52

risk to the Hanford cleanup mission, with a 95 percent chance of running out of DST space to continue retrieval of SST waste.<sup>25</sup> The May 2017 GAO report, which discussed the potential reduction in short-term risks and long-term costs from treating a portion of LAW with grout, stated that grouting could reduce the environmental risk posed by leaks from aging tanks by removing waste from such tanks sooner than vitrification would. The availability of DST space, including in SY-101, is thus integral to DOE's cleanup mission at Hanford. Grouting the TBI waste would free up 2,000 gallons of DST space that could be used for waste retrieved from SSTs, allowing for optimized retrieval sequencing to reduce environmental and human health risk more rapidly.<sup>26</sup>

Again, these distinctions as applied to the 2,000 gallons are small, but if the TBI demonstrates the effectiveness of a regulatory pathway for other Hanford low-activity waste via grouting and offsite disposal, that could substantially facilitate DOE's ability to meet its SST retrieval schedule and allow DOE to complete its cleanup mission in less time than it would if vitrification is required for all of Hanford's low-activity waste.<sup>27</sup> Grouting could provide an alternative treatment pathway that would allow 200 West Area tanks to be retrieved, and supernate from those tanks to be treated and disposed of offsite, decades earlier than the baseline approach of vitrification. Given that these tanks are well past their design life and are at risk of leaking, this would help mitigate the environmental risk of this tank waste (and attendant costs) sooner.

Second, vitrification of the 2,000 gallons of Tank SY-101 supernate would result in certain secondary impacts, which are unnecessary and avoidable under these circumstances given the efficacy of grouting, the protective geologic features of the

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<sup>25</sup> GAO-21-73

<sup>26</sup> See FFRDC 2023 page 52

<sup>27</sup> See GAO 22-104365, p. 44-45; GAO, GAO 21-73, *Hanford Cleanup, DOE's Efforts to Close Tank Farms Would Benefit from Clearer Legal Authorities and Communication* (January 2021). See, also, 2023 FFRDC Follow-On Report, Vol. 1, p. 9-11 (finding, for example, that every two years of WTP vitrification operations without LAW supplemental treatment adds one year to the overall mission).

identified disposal sites, and the terms of the proposed variance. When LAW is vitrified, the water present in LAW is not incorporated into the glass matrix as part of the treatment process. The water initially present in the LAW, as well as any water produced as part of the treatment process, must then be recycled back into the vitrification system or managed as a liquid secondary waste, which would contain low levels of radionuclides and hazardous constituents not otherwise immobilized or destroyed by the glass-forming step. In contrast, when pretreated LAW is grouted instead of vitrified, the water content of the waste is incorporated into the cementitious matrix.

Vitrification also generates secondary waste streams (such as high-efficiency particulate air filters, carbon adsorber beds, spent or failed melters, and melter components), whereas grouting generates minimal secondary wastes.<sup>28</sup> Furthermore, vitrification is a high temperature process that generates offgas that requires management and treatment for worker and public protection, whereas grouting takes place at much lower temperatures and is less energy-intensive than vitrification.<sup>29</sup>

Vitrification of TBI tank waste would also be more costly than grouting to achieve near-term risk reduction. Additional vitrification capability would need to be constructed before the TBI waste and any other low-activity waste from Hanford's 200 West Area could be vitrified. Multiple independent sources estimate the costs of grouting and off-site disposal vs vitrification.<sup>30</sup> For example, the 2023 FFRDC Follow-On Report states that grouting would minimize financial demands by reducing mission duration and lifecycle costs and indicates that grouting is clearly executable at benchmark funding levels.<sup>31</sup> In light of this, EPA believes grouting and offsite disposal of TBI waste in accordance with the terms of this approval would be cheaper than vitrification. Cost

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<sup>28</sup> See, 2023 FFRDC Follow-On Report, Vol. I, App. B.

<sup>29</sup> See, 2023 FFRDC Follow-On Report, Vol. I, p. 3-4.

<sup>30</sup> See 2019 FFRDC Report; 2022 GAO report; 2023 FFRDC Follow-On Report.

<sup>31</sup> GAO-17-306

savings can also be realized by reducing the amount of waste that needs to be managed in tanks. The GAO reported in 2021 that DOE spent more than \$400 million per year from 2017-2019 maintaining the waste in the tanks.<sup>32</sup> Finally, the reduction of waste quantity managed in aging tanks has the potential to reduce cleanups costs associated with waste leaking from the tanks.

EPA recognizes there are differences in reporting on how much time, cost, and secondary impacts would be reduced by grouting some of the Hanford low-activity waste rather than vitrifying it. However, EPA believes there would be savings under all three metrics.

Finally, the characteristics of the two facilities that would be authorized for disposal of the grouted waste form under the proposed variance support EPA's proposed determination that requiring HLVT would be technically inappropriate for the TBI waste as described below.

First, these two facilities feature favorable physical, including geologic, features, as described in section II.C below.<sup>33</sup> These features would help ensure that threats to human health and the environment posed by disposal of the grouted SY-101 supernate are minimized. EPA's proposed technical inappropriateness determination is dependent on its proposed threat minimization determination.

Second, because the pre-treated LAW will still contain radionuclides, EPA notes that disposal must be in accordance with the Nuclear Regulatory Commission's (NRC) performance objectives at 10 CFR part 61, Subpart C for disposal of LLW. The performance objective requirements for licensed MLLW disposal facilities in the Texas Administrative Code and the Utah Administrative Code mirror and are comparable to the

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<sup>32</sup> GAO-21-73.

<sup>33</sup> The geology underlying the IDF differs from the geology underlying these two facilities in certain respects, see Section II.C page 14 below.

NRC's performance objectives, as discussed in detail in the 2,000-gallon TBI Demonstration Final WIR Evaluation.<sup>34</sup>

For all the reasons above, EPA concludes that requiring treatment by vitrification would be technically inappropriate for this 2,000 gallons of Tank SY-101 supernate in view of the efficacy of grouting, the protective geologic features of the identified disposal sites, and the conditions specified in the proposed variance.

### *C. Proposed Minimization of Threat Determination*

EPA proposes to determine that grouting of the pre-treated, low activity fraction of the Tank SY-101 supernate, under the terms of the proposed variance, would minimize threats to human health and the environment posed by disposal of the waste. The proposed minimization of threat finding is predicated on the TBI waste being treated to the LDR standard of STABL, with verification through samples collected after grouting to demonstrate that the stabilization achieves the NWW LDR concentration-based and Toxicity Characteristic Leaching Procedure (TCLP)-based standards, as applicable, for F001-F005 (limited to constituents associated with spent solvent activities at the Facility); D001- D011, D018, D019, D022, D028-D030, D033-D036, D038- D041, and D043.

The EPA-approved STABL treatment technology is described as “[s]tabilization with the following reagents (or waste reagents) or combinations of reagents: (1) Portland cement; or (2) lime/pozzolans (e.g., fly ash and cement kiln dust)...” 40 CFR 268.42. This method includes the grouting technology that DOE requests approval for. As described above, EPA in the Third Third Rule preamble generally concluded that stabilization was an appropriate technology for low-level waste fractions that are separated from the high-level waste generated during the reprocessing of fuel rods. To comply with STABL, the offsite commercial treatment facilities would be required to use

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<sup>34</sup> See Final WIR Evaluation, p. 4-2; 5-1.

the appropriate stabilization methods that meet applicable regulatory requirements in accordance with the facilities' waste permits and radioactive material licenses, as applicable.

Moreover, under the proposed variance, the grouted waste would be required to meet the numerical treatment standards applicable to the waste codes for the subject waste. While confirmation sampling would not typically be conducted for waste subject to the STABL standard, since it is a method-based standard, sampling after treatment at the offsite commercial treatment facilities would be conducted for the purpose of validating treatment performance against the NWW numerical standards at 268.40 and, as applicable, at 268.48.<sup>35</sup> EPA determined in promulgating these numerical standards that they minimize threats posed by disposal of hazardous waste bearing the relevant waste codes, as required by RCRA section 3004(m).

Based on the sampling data provided by DOE, EPA fully expects that the numerical treatment standards will be met. All metals other than chromium are below NWW TCLP standards based on their measured total concentrations in Tank SY-101. A previous grouting recipe used by DOE provided a retention factor for chromium which can be used to predict the TCLP concentrations found in the final grouted waste form. This demonstration showed that the chromium TCLP leachate concentration in the grouted waste form would be two to three orders of magnitude less than the NWW TCLP numerical standard.<sup>36</sup> While this grout recipe may not be identical to the recipe used in

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<sup>35</sup> DOE has requested this confirmation sampling in the context of the 2,000-gallon TBI to support and inform the development of a possible method-based treatment standard for other Hanford tank waste. DOE indicates that it may submit a variance request in the future for other tank waste that may provide a basis to eliminate the need for post-treatment sampling. Today's proposal is limited to the 2,000-gallon TBI, and EPA expresses no view as to the appropriateness of proposals DOE may advance in the future for treatment of other Hanford tank waste.

<sup>36</sup> DOE details in their petition: In Tank SY-101 supernate, chromium was detected at 95.8 mg/L. Available data on chromium in relation to DOE's Cast Stone formulation indicate that the retention factor for chromium is between  $3.3 \times 10^{-5}$  and  $1.3 \times 10^{-4}$  ( $\text{mg\_Cr/L\_leachate} / \text{mg\_Cr/kg\_solid}$ ), which corresponds to an EPA SW-846 Method 1311 TCLP concentration of between  $9.9 \times 10^{-4}$  and  $3.9 \times 10^{-3}$

this proposed action, grouting is generally BDAT for metal constituents and is therefore expected to immobilize the chromium and therefore minimize threats.<sup>37</sup>

As described earlier, the organic wastes are already at least an order of magnitude below the NWW standards, except for 1-butanol, which below or just slightly above the treatment standard. For this reason, targeted organics destruction or removal in addition to grouting is not necessary to minimize threats to health and the environment.

EPA's proposed determination is supported by independent assessments. For example, experts convened by the National Academies of Science in 2016 concluded that both vitrification and grout could effectively treat Hanford low activity waste and be protective of human health.<sup>38</sup>

Finally, the treatment and disposal facilities that would be authorized by this variance are particularly appropriate for this waste. Most importantly, the grouted waste form will be disposed of at *EnergySolutions* in Utah and/or Waste Control Specialists in Texas, both of which are commercial facilities that are RCRA-permitted and licensed by the applicable State authorities pursuant to their agreement with the NRC to accept mixed waste in accordance with their Waste Acceptance Criteria. Because the pre-treated LAW will still contain radionuclides, disposal must be in accordance with the NRC performance objectives at 10 CFR part 61, Subpart C for disposal of LLW. The performance objective requirements for licensed MLLW disposal facilities in the Texas Administrative Code and the Utah Administrative Code mirror and are comparable to the NRC's performance objectives, as discussed in detail in the 2,000-gallon TBI

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(mg\_Cr/L\_leachate). In contrast, the NWW treatment standard for chromium is 0.6 (mg\_Cr/L\_leachate). Thus, the TCLP leachate concentration for the grouted waste form is expected to be two or three orders of magnitude less than the NWW numerical standard.

<sup>37</sup> EPA 402-R-96-014, *Stabilization/Solidification Processes for Mixed Waste*, page 36.

<sup>38</sup> GAO-22-104365, *Nuclear Waste Disposal: Actions Needed to Enable DOE Decision That Could Save Tens of Billions of Dollars*, at 50-51.

Demonstration Final WIR Evaluation. Those licensed facilities are subject to regulations and conditions that ensure the protection of public health and safety and the environment.

The disposal facilities were also specifically selected based on their location, geology, hydrogeology, and experience in receiving comparable waste types for disposal. The EnergySolutions facility is located in a remote area of Utah with low-permeability clay soils immediately under the facility. Any potential for exposures via the groundwater pathway is further reduced due to naturally poor groundwater quality at the site which is extremely saline and exceeds EPA and Utah State drinking water standards for several naturally occurring constituents.<sup>39</sup> No domestic water use occurs within 10 km of the facility.<sup>40</sup> The precipitation levels in the area are low, evaporation is high, and the nearest stream channel is 2 miles east of the facility, thus minimizing the potential for releases via any surface water pathway.<sup>41</sup> All of those characteristics make the site well-suited for the disposal of the TBI waste.

Similarly, the Waste Control Specialists FWF facility is in a physical setting that is naturally protective of human health and the environment. The area receives less than 16 inches of precipitation annually and evapotranspiration exceeds precipitation rates.<sup>42</sup> There are no perennial streams on or near the site.<sup>43</sup> The site sits on top of a 600-ft geologic layer of silts, muds and other low-permeability constituents.<sup>44</sup> The first continuously saturated zone is 225 ft below ground surface and has extremely low permeability, retaining water from the Pleistocene era.<sup>45</sup> The water volume is not sufficient to support an individual, and is non-potable.<sup>46</sup>

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<sup>39</sup> 2023 FFRDC Follow-On Report, Vol. II, p. G-13.

<sup>40</sup> 2023 FFRDC Follow-On Report, Vol. II, p. G-18.

<sup>41</sup> 2023 FFRDC Follow-On Report, Vol. II, p. G-18.

<sup>42</sup> 2023 FFRDC Follow-On Report, Vol. II, p. G-33.

<sup>43</sup> 2023 FFRDC Follow-On Report, Vol. II, p. G-33.

<sup>44</sup> 2023 FFRDC Follow-On Report, Vol. II, p. G-27.

<sup>45</sup> 2023 FFRDC Follow-On Report, Vol. II, p. G-31.

<sup>46</sup> 2023 FFRDC Follow-On Report, Vol. II, p. G-31.

The geologic features, low infiltration, and no credible pathway to surface water or potable water aquifers at both EnergySolutions in Utah and Waste Control Specialists in Texas provide additional long-term environmental protections for waste that would help ensure that threats to human health and the environment posed by the disposal of the grouted SY-101 supernate are minimized.<sup>47</sup> Conversely, with respect to geology, Hanford’s IDF overlies unconsolidated to semi-consolidated sediments with no intervening natural barrier between the landfill and the underlying aquifer. However, EPA is not making a decision on whether a variance would be appropriate for disposal in landfills other than those evaluated in the petition.

*Table 1. Proposed modification to 40 CFR 268.44(o) for the TBI Demonstration Petition:*

Wastes Excluded from The Treatment Standards Under § 268.40							
Facility Name and address	Waste Code	See also	Regulated hazardous constituent	Wastewaters		Nonwastewaters	
				Concentration (mg/L)	Notes	Concentration (mg/L)	Notes
United States Department of Energy (Energy), Richland, WA <sup>17</sup>	F001-F005  D001-D011, D018, D019, D022, D028-D030, D033-D036, D038-D041, and D043 <sup>18</sup>	NA	For waste codes F001-F005, the constituents are limited to those associated with spent solvent activities at the Facility documented through process knowledge.  For constituents, as applicable, associated with D waste codes under the “Waste	NA	NA	STABL <sup>19, 20</sup>	NA

<sup>47</sup> 2023 FFRDC Follow-On Report, Vol. I, p. 52.

			Code” column, see 40 CFR 268.40.				
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<sup>17</sup> – The STABL treatment standard applies to the separated and pretreated tank waste under the 2,000-gallon TBI Demonstration.

<sup>18</sup> – The waste codes included in this column are those identified on the current version of the Dangerous Waste Permit Application Part A form for the Hanford Double Shell Tank System, Rev. 04 (December 14, 2009), except for F039 which has not been accepted into the Double Shell Tanks.

<sup>19</sup> – Sampling after treatment will be conducted at the treatment facility for the purpose of assessing the extent of treatment performance against the NWW numerical standards at 268.40 and, as applicable, at 268.48. Waste treated using STABL may not be land disposed until LDR constituents are below the non-wastewater numerical standards at 40 CFR 268.40 and 268.48.

<sup>20</sup> – Treatment using the STABL treatment method shall be performed, and the treated waste shall be disposed of, at EnergySolutions in Clive, Utah, and/or Waste Control Specialists in Andrews County, Texas.

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